Kunio MITUI*: Chromosome studies on Japanese ferns (1)

三井邦男*: 日本のシダの染色体の研究 (1)

Since Manton has published "Problems of Cytology and Evolution in the Pteridophyta," cytotaxonomic studies in the Pteridophyta have been done by many investigators. I have observed the chromosomes of the Japanese fern and got some new records. Table 1 is an arrangement of the results in 38 species. In these studies spore mother cells were observed by the usual aceto-carmine squash technique. I am indebted to Prof. H. Ito for valuable advice and for identification of the materials.

Notes and discussions

Athyrium. Mehra and Verma (1957) reported the haploid chromosome number 40 and 80 for *A. pycnosorum*, and also Kurita (1960) founded n=80 in the same species. I counted 40 bivalents at diakinesis in this species (fig. 9). Therefore it seems that there are two types of the haploid chromosome number, 40 and 80 in this Japanese species as Indian species. Kurita (1960) reported the haploid chromosome number 80 for *A. conilii.* The present specimen showed clearly 120 bivalents at diakinesis (fig. 7) and this number was reported also *A. conilii* var. *oldhamii* by Kurita (1960). Therefore it seems that this species has two polyploid races, namely tetraploid and haxaploid, as *A. japonicum* which has three polyploid races, viz. diploid (Bir, 1961), tetraploid (Bir, 1961), and hexaploid (Kurita, 1960).

Camptosorus. I counted 36 bivalents at diakinesis in *C. sibiricus* (fig. 12) and 64 spores in a sporangium. Wagner (1954) observed the haploid chromosome number 36 in another species, *C. rhizophyllus* of this genus. Therefore the basic number of the genus is x=36.

Cyrtomiun. Manton (1950), Mehra (1961), Abraham, Ninan and Mathew (1962) reported n=2n=123 in *C. falcatum.* I studied two cytological types of *C. falcatum*, and one is triploid apogamous fern (n=123) and the other is diploid or tetraploid (n=82). The former produces 32 spores in a sporangium, but the spore number of the latter is not studied for lack of good materials.

Lepisorus. Many authors have reported various chromosome numbers in

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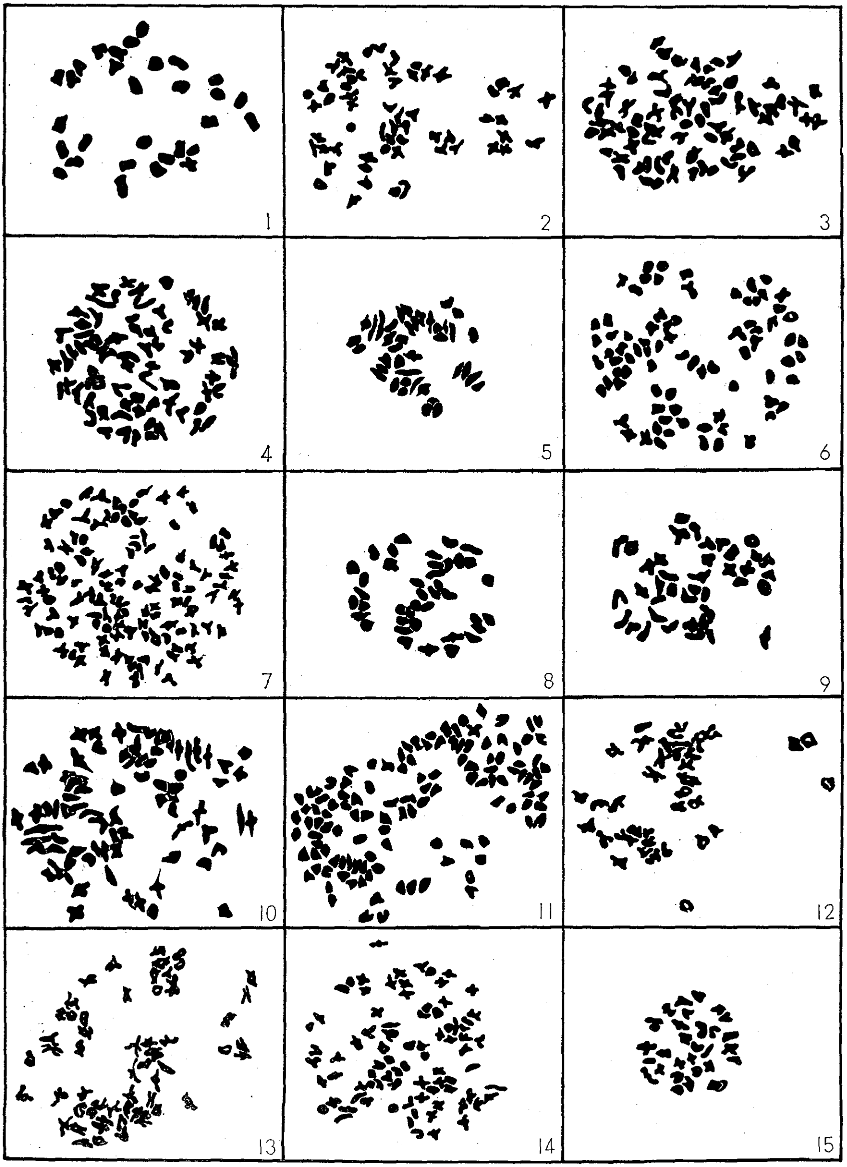
Table 1. A list of chromosome numbers of some Japanese ferns.

Name of species	Japanese name	Locality	Chromosome number	Number of spores	Ploidy	Fig.
Adiantum capillus-veneris L.	Hôraisida	U.T.*	n=30	64	2x	1
A. monochlamys Eaton	Hakonesida	T.U.E.*	n=58	64	4x	2
Asplenium pekinense Hance	Tokiwatoranoo	Mt. Gozen, Tokyo Pref.	n=72	64	4x	3
A. tripteropus Nakai	Inu-tyasensida	Mt. Hunakosi, Hyogo Pref.	n=72	64	4x	4
Athyrium brevifrons Nakai	Ezo-mesida	U.T.	n=40	64	2x	5
A. clivicola Tagawa	Karakusa-inuwarabi	Hitoyosi, Kumamato Pref.	n=80	64	4x	6
A. conilii Tagawa	Hosoba-sikesida	Mt. Kiyosumi, Tiba Pref.	n=120	64	6x	7
A. frangulum Tagawa	Miyako-inuwarabi	Mt. Ozaku, Totigi Pref.	n=40	64	2x	8
A. pycnosorum Christ	Miyama-sikesida	T.U.E.	n=40	64	2x	9
A. squamigerum Ohwi	Kiyotakisida	Ongata, Tokyo Pref.	n=80	64	4x	10
A. unifurcatum C. Chr. var *unifurcatum*	Ôhime-warabi-modoki	T.U.E.	n=120			11
Camptosorus sibiricus Rupr.	Kumonosu-sida	Mt. Gozen, Tokyo Pref.	n=36	64	2x	12
Cheilanthes argentea Kunze	Himeuraziro	Hitoyosi, Kumamoto Pref.	n=58–60			13
Cyrtomium falcatum Pr.	Oni-yabusotetu	Hitoyosi, Kumamoto Pref.	n=82			14
Dennstaedtia wilfordii Koidzumi	Ôrensida	Ongata, Tokyo Pref.	n=31	64	2x	15
Diplazium subsinuatum Tagawa	Herasida	Zinmuzi, Kanagawa Pref.	n=123	64	6x	16
Dryopteris atrata Ching	Iwahego	Mt. Hunakosi, Hyogo Pref.	n=123	32	3x apog.	17
D. bissetiana C. Chr. var. *sacrosancta* H. Ito	Hime-itatisida	Hitoyosi, Kumamoto Pref.	n=123			18
D. dickinsii C. Chr.	Ôkuzyaku	T.U.E.	n=82	32	2x apog.	19

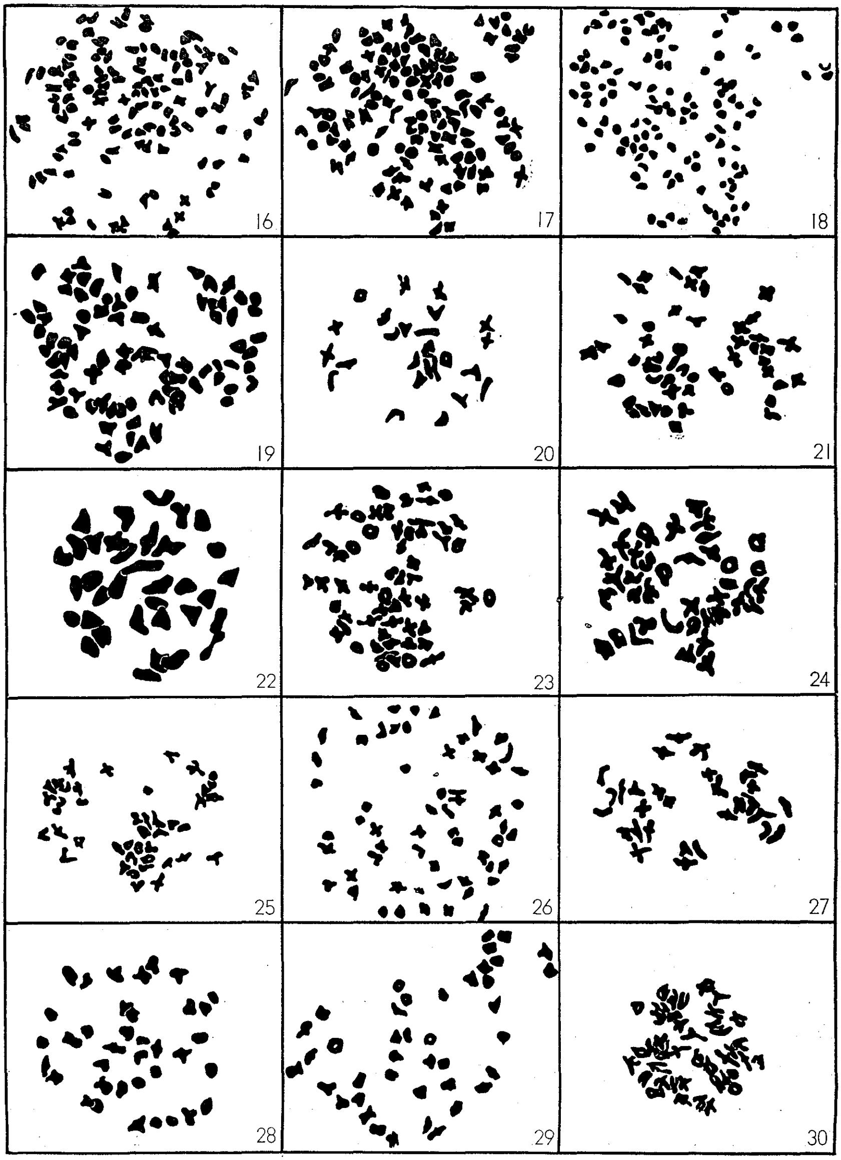
Lepisorus onoei Ching	Hime-nokisinobu	Hanno, Saitama Pref.	n =25	64		20
L. thunbergianus Ching	Nokisinobu	Hanno, Saitama Pref.	n =50	64		21
Loxogramme salifolia Makino	Iwayanagisida	Yadake, Kumamoto Pref.	n =35	64	2x	22
Lygodium japonicum Sw.	Kanikusa	Hitoyosi, Kumamoto Pref.	n =58		4x	23
Matteuccia struthiopteris Todaro	Kusasotetu	T.U.E.	n =40	64	2x	24
Microlepia strigosa Pr.	Isikaguma	U.T.	n =43	64	2x	25
Onychium japonicum Kunze	Tatisinobu	Hasimoto, Kanagawa Pref.	n =58	64	4x	26
Phegopteris decursive-pinnata Fée	Gezigezisida	Ongata, Tokyo Pref.	n =30	64	2x	27
Polypodium fauriei Christ	Osyaguzidenda	Mt. Gozen, Tokyo Pref.	n =37	64	2x	28
Polystichopsis aristata Ching var. *aristata*	Hosoba-kanawarabi	T.U.E.	n =41	64	2x	29
P. miqueliana Tagawa	Naraisida	Mt. Kawanori, Tokyo Pref.	n =41	64	2x	30
P. standishii Tagawa	Ryômensida	U.T.	n =41	64	2x	31
Polystichum igaense Tagawa	Tyaboinode	Mt. Ozaku, Totigi Pref.	n =41	64	2x	32
P. tsussimense J. Sm.	Hime-kanawarabi	Mt. Kiyosumi, Tiba Pref.	n =123	32	3x apog.	33
Pteris cretica L.	Ôbano-inomotosô	Hitoyosi, Kumamoto Pref.	n =87	32	3x apog.	34
P. inaequalis Bak. var. *aequata* Tagawa	Ôbano-hatizyôsida	Mt. Kiyosumi, Tiba Pref.	n =29	64	2x	35
P. multifida Poir.	Inomotosô	T.U.E.	n =58	64	4x	36
Woodsia manchuriensis Hook.	Hukurosida	Mt. Gozen, Tokyo Pref.	n =33	64		37
Woodwardia japonica Sm.	Ôkaguma	Hitoyosi, Kumamoto Pref.	n =34	64	2x	38

* Abbreviation: T.U.E. Fern garden of Tokyo University of Education. U.T. Koishikawa Botanical Garden of University of Tokyo.

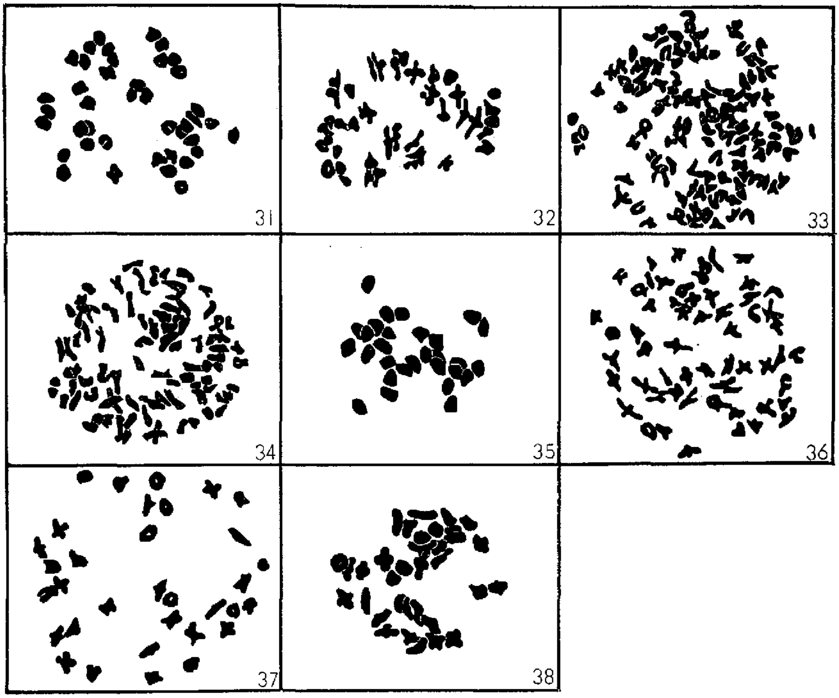
this genus. Malhotra (in Mehra, 1961) reported n=35 for *L. excavatus*, *L. kashyapii* and *L. nudus* and further n=36 for *L. excavatus* var. *scolopendrium* and n=26 for *L. loriformis*. Panigrahi and Patnaik (in Fernando, 1963) reported 2n=39 for *L. pseudonudus* and n=22 for a new species. Manton (1957) observed



Figs. 1-15. Numbers correspond to those in tab. 1. (×600).



Figs. 16-30. Numbers correspond to those in tab. 1. (×600).

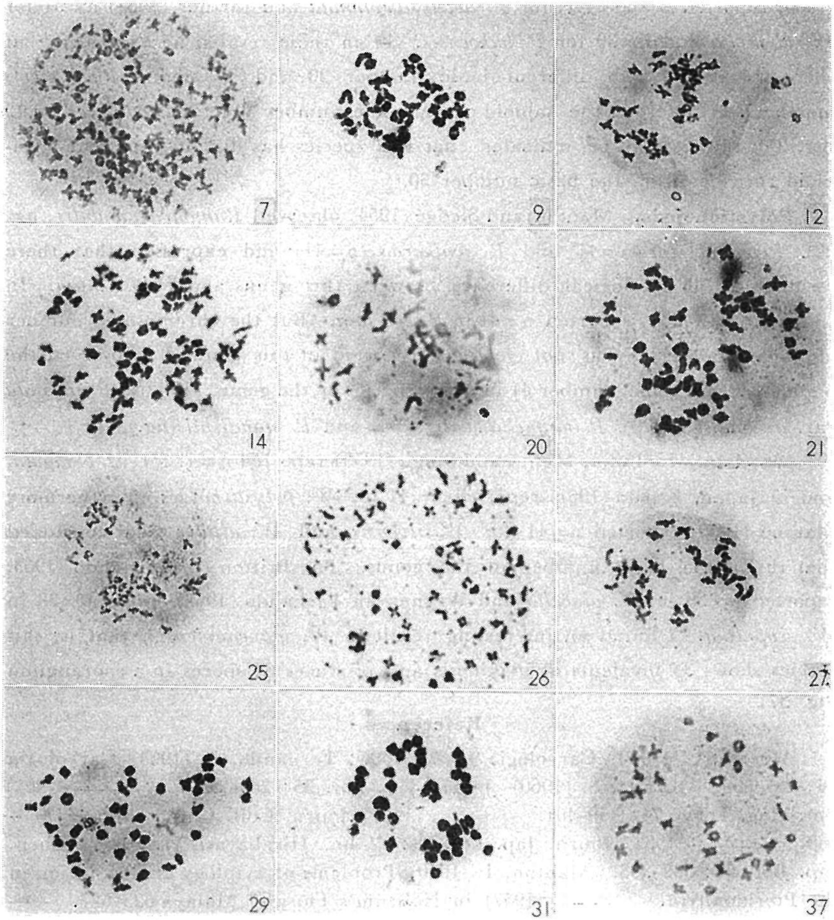


Figs. 31-38. Numbers correspond to those in tab. 1. (×600).

2n=74 in *L. longifolius*. Panigrahi and Patnaik (in Fernando, 1963) reported n=23 and 2n=46 for *L. contortus*. I counted 25 bivalents at diakinesis in *L. onoei* and 50 bivalents in *L. thunbergianus* and both of them produced 64 spores in a sporangium (figs. 20, 21).

Microlepia. Chromosome numbers of this genus have been reported in some species. Manton (1958) reported n=129 for *M. speluncae*, but Manton and Sledge (1954) observed n=86 in the same species and further Mehra and Khanna (1959) counted n=43 in this. Mehra and Khanna (1959) reported n=43 for *M. rhomboidea* and *M. pilosula*. In other, Kurita (1963) found 2n=160 in *M. pseudostrigosa* and expressed that this number might suggest a different basic number (x=40) which have induced a tetraploid species as such. But I counted 43 bivalents in the first meiotic metaphase (fig. 25) in *M. strigosa* which is allied closely to *M. pseudostrigosa*.

Onychium. Mehra and Verma (1957) reported the haploid chromosome



Selected photographs. Numbers correspond to those in tab. 1, and figs. (×450).

number 29 for *O. auratum* and *O. japonicum* and n=58 for apogamous species *O. contiguum*. From these results they expressed that the basic number of the genus is x=29. I observed 58 bivalents at diakinesis in *O. japonicum* (fig. 26) which produced 64 spores in a sporangium, thus this is a tetraploid race and this species has two types of polyploidy.

Phegopteris. Manton (1950) reported n=90 for the apogamous species *P. polypodioides* and concluded that the basic number of the genus is x=30. Kurita

(1960) reported $n=60$ (±1) for *P. decursivepinnata* and further (1964) $n=31$ for *P. subaurita* and $n=30$ for *P. bukoensis*. From these results, he expressed that there are at least two different basic number 30 and 31 among *Phegopteris* members. I observed the haploid chromosome number 30 in *P. decursivepinnata* (fig. 27), thus it may be indicated that this species has diploid race and tetraploid race based on the basic number 30.

Polystichopsis. Manton and Sledge (1954) observed *Rumohra amabilis* ($n=82$), *R. carvifolia* ($n=41$) and *R. walkerae* ($n=41$) and expressed that there seems to be no cytological difference between this genus and *Polystichum*. In India, Loyal (1958) reported $n=41$ in *R. speciosa*. But the chromosome number of Japanese species has not yet been reported in this genus. I observed the haploid chromosome number 41 in three species of the genus, that is, *P. aristata* var. *aristata* (fig. 29), *P. miqueliana* (fig. 30), and *P. standishii* (fig. 31).

Woodsia. In India, Mehra and Singh (1955) reported $n=41$ for *W. elongata*, and in Japan, Kurita (1961) reported $n=41$ for *W. polystichoides*. Furthermore Manton (1950) reported $n=41$ for *W. ilvensis* and *W. alpina* and concluded that this is the basic number of the genus. But Britton (in Fernando, 1963) reported $n=39$ in *W. glabella* and Wagner (in Fernando, 1963) found $n=38$ in *W. scopulina*. I found an interesting result in *W. manchuriensis*, that is, this species shows 33 bivalents at diakinesis and produces 64 spores in a sporangium (fig. 37).

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私はシダの染色体数を調べているが，日本産の 38 種類についての新知見を得たので報告する。表 1 と図ならびに写真がその詳細である。イワデンダ属の $\mathbf{x}=33$ とノキシノブ属の $\mathbf{x}=25$ が新しい基本数である。ホソバシケシダ，ミヤマシケシダ，タチシノブ，オオバノイノモトソウが二つの倍数体をもつことがわかった。